

CHE3025, Physical Chemistry I

Syllabus, Spring 2023, Jan. 10 – May. 5



The first semester of Physical Chemistry focuses on thermodynamics, statistical mechanics, and reaction kinetics. The fundamental goals are to understand *why* chemical systems act as they do, and how to predict what will happen in new situations. Much of this course covers ideas introduced throughout General Chemistry, but with much more detail and rigor to apply to a broader range of circumstances.

Throughout this semester, I strongly encourage you to review class work regularly, practice problems daily and ask as many questions as necessary in order to succeed. Talk to me one-on-one early and often; helping students directly is one of my favorite parts of my job.

Dr. Samuel Stoneburner, Assistant Professor

Office: Rohr Science 322 (enter through 330)

Email: sstonebu@pointloma.edu

Phone: 619-849-7230

Lecture location: Ryan Learning Center 104

MWF: 8:30 am – 9:25 am

Final: Mon., May 1, 7:30 am – 10:00 am

Communication: I will post information and announcements via Canvas. You should activate notifications. When I am not available in my office, the best way to reach me is by email. I will attempt to respond within one business day.

Drop-in Hours: MWF, 1:00 pm – 2:30 pm, Thursdays, 9:30 am – 11:00 am

You do not need an appointment to meet with me during any of the above hours.

If you would like to meet me outside of the above hours, email me to schedule an appointment.

Please provide suggested meeting times between 9am and 4pm.

Drop-in TA: Hannah Knipmeyer, MW, 7:00 pm – 8:00 pm, Location TBD

Prerequisite(s): CHE 2013 (Analytical Chemistry)

PHY 1054 or PHY 2054 (General Physics II or University Physics II)

MTH 1044 or MTH 1064 (Calculus With Applications or Calculus I),

C– or better in all prerequisite classes strongly recommended

Corequisite(s): CHE 3025L (lab, graded separately)

Course Description: Study of classical thermodynamics as it is applied to physical and chemical systems. Includes discussion of the three laws and their application to thermochemistry, reaction energetics and chemical equilibrium.

Course Materials:

- *Textbook:* Engel & Reid, Thermodynamics, Statistical Thermodynamics, and Kinetics Plus Modified MasteringChemistry with eText, Pearson, 4th Edition, ISBN-13: 9780134813455 (hardcover text), 9780134813790 (looseleaf text), or a [Pearson+ monthly subscription](#) (e-text only, cheapest option)
- *Online Homework:* MasteringChemistry mlm.pearson.com/northamerica/masteringchemistry/ (bundled with text or purchased separately). Access through Canvas.
- *Workbook:* Shepherd, et al. Thermodynamics, Statistical Mechanics Kinetics: A Guided Inquiry, Kendall Hunt, ISBN-13: 9781792498374. Print or e-book is acceptable, but plan on writing in it.

About your professor: Dr. Stoneburner earned his associate's degree while renovating a local hardware store, his bachelor's degree while acting in minor roles in college theatre, and his doctorate while getting married and adopting four children. His hobbies include PC gaming (mainly single-player RPGs). It has never been proven that he attempted to steal the moon in order to take over the entire Tri-State Area, but even if he did do that, everything changed when the fire nation attacked and he took an arrow to the knee.

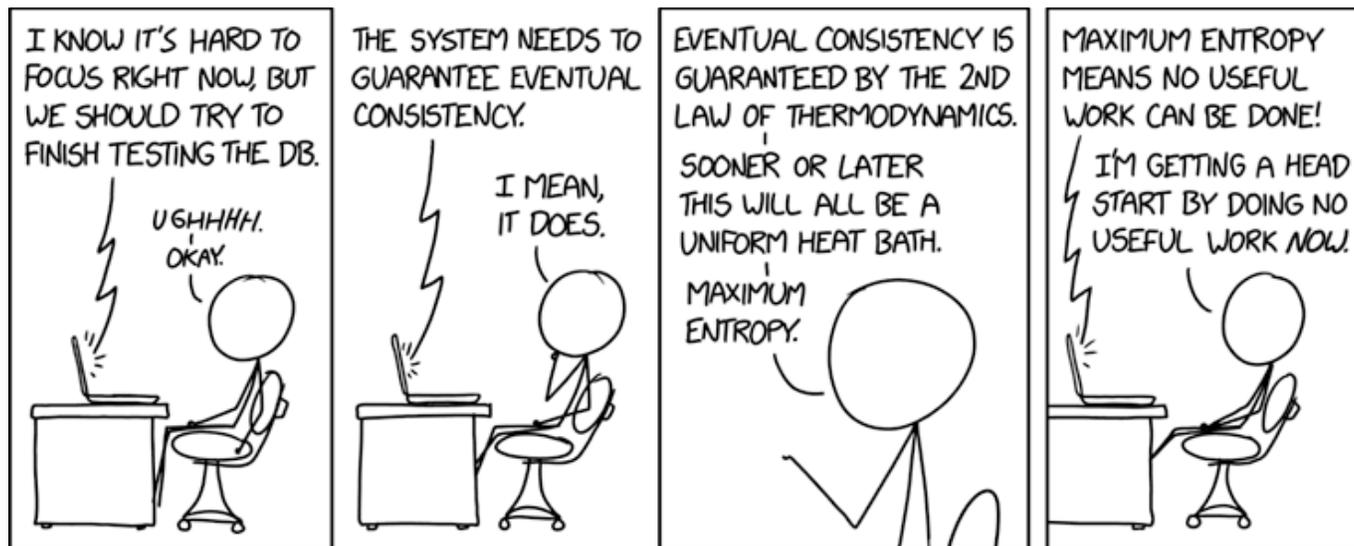
PLNU Mission: To Teach ~ To Shape ~ To Send

Point Loma Nazarene University exists to provide higher education in a vital Christian community where minds are engaged and challenged, character is modeled and formed, and service is an expression of faith. Being of Wesleyan heritage, we strive to be a learning community where grace is foundational, truth is pursued, and holiness is a way of life.

Course Learning Outcomes: Upon completion of this course, students will be able to:

- Appreciate the order and intricacy of God's handiwork in nature.
- Understand fundamental concepts and principles of thermodynamics, statistical mechanics, and kinetics.
- Explain macroscopic chemical systems in terms of microscopic properties.
- Predict properties and behaviors of chemical systems.
- Solve quantitative chemical problems.
- Identify and explain necessary assumptions or limitations in applying equations or concepts to chemical problems.
- Communicate scientific ideas and results in writing.
- Apply physical chemistry concepts to the benefit of their community.

CHEM PLO 2 (UV-vis) and BCHM PLO 3 (UV-vis) will be assessed directly by faculty laboratory instructors' observation of students' use of instruments.



xkcd.com/2315/

Academic success: This course will require significant effort from all of us. Merely attending lecture will not be enough. Merely reading the textbook will not be enough. Merely completing the assigned homework as a rote exercise will not be enough. You need to *understand* the course material and be able to apply it in new situations. You will be shown concepts, ideals, problem-solving strategies, and examples, but in the end you should be able to use what you have learned in a much wider range of situations than the ones considered in class. Here are some tips to help you get there:

Before each class:

Read the assigned chapter sections and make notes of anything that is confusing or difficult.
Complete the reading survey in Canvas.

During each class:

Have your notes from the pre-lecture reading handy. Some questions may be answered (hopefully) throughout the lecture. Ask questions to clarify anything that remains confusing.

After each class:

Look over the textbook again, especially the parts that seemed difficult before. Look over previous textbook sections as much as needed to reinforce relevant ideas and connections.
Attempt assigned homework as early as possible. This will give you more time to come in to office hours or ask questions over email as much as needed.

After you have completed assigned work, **keep going**. Do additional problems from the end of each chapter. You can check your answers by emailing Dr. Stoneburner.

Don't stop practicing when you get it right; keep practicing until you can't get it wrong.

I am aware that you have other demands on your time, but this is what it will take to master Physical Chemistry. The PLNU Credit Hour Policy states that **2 hours of preparation per 1 hour of class time is "normal", meaning 5.5 hours per week (besides lecture itself)** for the CHE 3025 lecture course. If you find math intimidating or find yourself struggling to keep up, you may need additional time. There is no shame in that. If you put the time in, and do so usefully, you will probably understand the content much better than the student who seems to get all the right answers in the first few minutes of trying.

You can maximize the effectiveness of your time by giving yourself a focused environment. Do not try to "multitask" with videos or social media while you are working on chemistry. ("Multitask" is a word that here means "doing a poor job of multiple tasks simultaneously". That is what "multitask" *always* means.) I also recommend caution when consulting other resources on the internet. There is an abundance of misinformation online, much of it intentional. (This is especially true with thermodynamics.)

Most of all, know that I am here to help, and your asking me questions early and often goes a long way towards making sure your precious time is spent as productively as possible. I want to see you succeed, and I look forward to participating in that success.

Grading and Assessment

“The risk I took was calculated, but man, am I bad at math.” – The Mincing Mockingbird

Letter grades will be assigned according to the following scheme:

A-range	B-range	C-range	D-range	F-range
A: Any grade of 93.0% or above.	B+: 87.0-89.9 % B: 83.0-86.9 %	C+: 77.0-79.9 % C: 73.0-76.9 %	D+: 67.0-69.9 % D: 63.0-66.9 %	F: Any grade below 60.0%
A-: 90.0-92.9 %	B-: 80.0-82.9 %	C-: 70.0-72.9 %	D-: 60.0-62.9 %	

Percent	Component
5 %	Reading surveys
10 %	In-class activities
15 %	Mastering Chemistry online assignments
15 %	Public education project
5 %	Quizzes
30 %	3 Exams (10% each)
20 %	Final Exam
100 %	Total

- “Extra credit”, “curving”, or “rounding up” of the final grade should not be expected or requested. The only way to achieve a given grade is to perform well on the assignments described here.
- “Points” will vary in significance depending on the total number of points available in a given component. Total points in a given category may change, but the percentage contributions given in the chart above will remain the same.

Reading surveys: For each class period with a reading assignment there will be a **survey** on Canvas (due 11:59 pm the night before that lecture day). The survey will typically have an open-ended question designed to highlight a key point in the reading and a place to put down two questions you had *about the reading*. Credit is based on whether you respond, not on whether you get a “right” answer.

In-class worksheets: Throughout the semester there will be a variety of in-class activities designed to help you get practice thinking through many of the more important concepts. Typically these worksheets will be done in small groups, and your participation benefits both you and your classmates. Credit is awarded for any good-faith participation.

Mastering Chemistry online homework (access through Canvas): The Mastering Chemistry content includes assigned homework problems as well as pre-lecture activities. Practicing what you are learning both before and after attending lecture is the most active (and most effective) part of your efforts in the course. Due dates will be found within the Mastering Chemistry system and on Canvas. The deadlines for assignments will generally be 11:59pm on Mondays, Wednesdays, and Fridays. The day immediately before an exam will also tend to have one or two assignments due, followed by a couple of days off immediately after the exam.

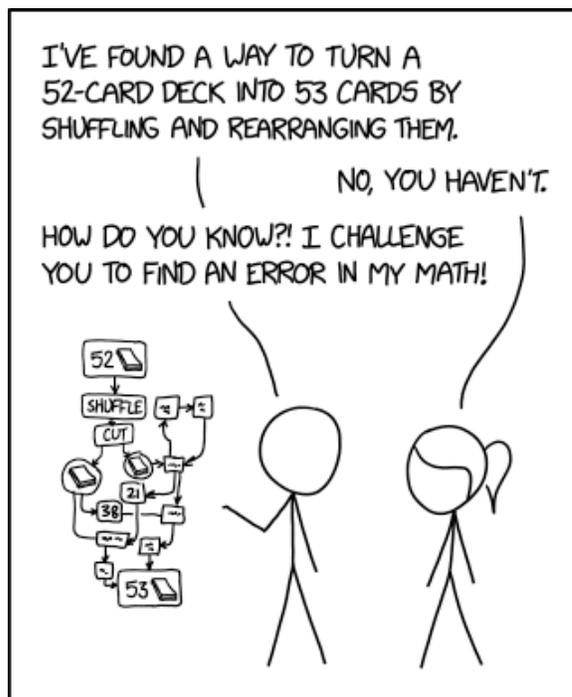
If you find yourself struggling with a problem repeatedly (e.g., 5 wrong answers to the same problem), you should come to my office hours and ask for help. I recommend you use a notebook for working out solutions to homework problems. Using a notebook creates a written record that you can consult later as you study or seek assistance, and it can be beneficial in the event of academic integrity questions. A notebook with your work on previous attempts to a problem is especially helpful when you are asking for my assistance.

After completing the assigned work, you can find additional practice in the end-of-chapter problems in the textbook. Doing so is *strongly* recommended and I am happy to help you with any questions that may come from any of those problems.

Public education project: With any course I teach at PLNU, I try to think about how to best connect with Christian identity. For this class, I want us to think about the responsibility we have as scientists to use our knowledge and skills for the betterment of our communities and the people therein. You will do this by identifying some real-world challenge, problem, or opportunity relevant to *your* community that you believe could be addressed in some way using any of the concepts from CHE3025. You may define “community” as narrowly or broadly as you see fit, whether it is something within your own home or an issue of global scale, but I want you to feel some connection to it. You will then write a detailed explanation of the issue and the relevant physical chemistry concept(s) at a level suitable for the general public. The goal here is not academic formality, it is to get practice in educating nonexperts in scientific ideas that impact them. For an example of the level of helpfulness and (lack of) formality I have in mind, consider [XKCD’s “What If?” blog](#). (The linked entry describes why dropping comets into the ocean is *not* a helpful solution to climate change. Debunking popular solutions along these lines is fair game for the assignment, as explaining what *can’t* work is at least as important as offering ideas that *might* work.)

This project will include four stages, with points out of 100 total:

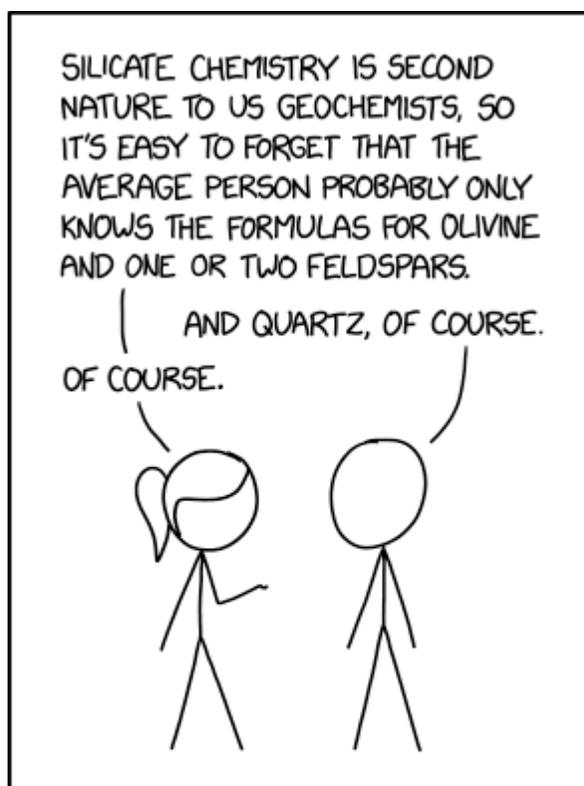
- Topic approval (10 pts). You will submit a brief description of the community you have in mind, the issue, and the physical chemistry topic(s) you will explain. I will look over what you have planned and offer feedback (including asking you to change your topic if it does not meet the requirements). Any complete submission before the due date will receive full credit.



EVERY CONVERSATION BETWEEN A PHYSICIST AND A PERPETUAL MOTION ENTHUSIAST.

xkcd.com/2217

- Rough draft (20 pts). You will submit a complete, if unpolished, version of the assignment to Turnitin (through Canvas). This may help you catch undue similarities in wording to your sources. Any complete submission before the due date will receive full credit (unless a large portion is copied too closely from outside sources).
- Peer review (20 pts). You will each read through a classmate's rough draft, "grade" it according to a provided rubric, and offer suggestions for improvement. (This is a crucial part of science communication, regardless of the audience.) For this part, credit is given based on the thoroughness and helpfulness of *your review*, not for the "grade" you get from your own reviewer.
- Final submission (50 pts). You will submit your final version to Turnitin (through Canvas). Credit will be awarded according to the same rubric provided with at the peer review stage. Factors will include scientific accuracy, accessibility of language (again, the target audience is the *general public*), clarity in general, correctness of grammar (with allowances for informal tone), relevance to the community, and relevancy of the physical chemistry topic(s) to the stated issue.



EVEN WHEN THEY'RE TRYING TO COMPENSATE FOR IT, EXPERTS IN ANYTHING WILDLY OVERESTIMATE THE AVERAGE PERSON'S FAMILIARITY WITH THEIR FIELD.

xkcd.com/2501

Quizzes: There will be quizzes roughly once per week covering content from the most recent few lectures. The day of the week and the delivery method (e.g., in-class vs. online) may vary. The quizzes will help you assess your understanding of the material, especially as you are preparing for exams. Look at them as additional opportunities to identify areas where you need my help or additional practice before your next exam.

Exams: Exam days are on the course schedule at the end of the syllabus. Exams will not be moved outside of truly extraordinary circumstances. Make-up exams will generally not be offered unless you get my permission before the exam *and* you must miss the scheduled exam time due to illness or similar circumstances beyond your control.

Final Exam: The final exam will be on Monday, May 1st, 7:30 am – 10:00 am. PLNU policy is that the final exam is required and that it must be given at the scheduled time. Travel arrangements are *not* a valid reason to request a change to the final exam.

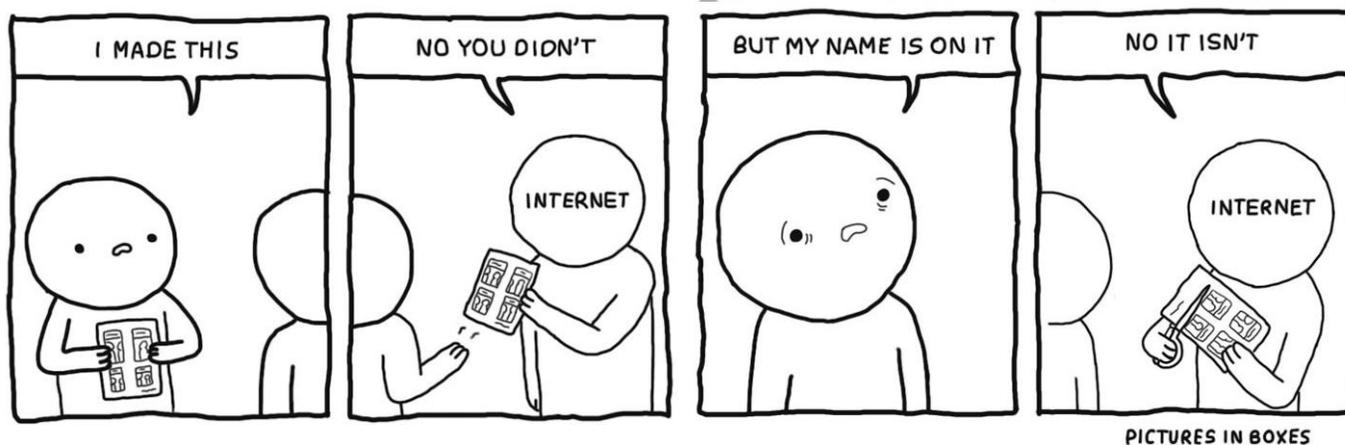
Additional Notes and Policies

“Good men don't need rules. Today is not the day to find out why I have so many.” – Doctor Who

Incompletes and late assignments: All assignments are to be submitted/turned in by the beginning of the class session when they are due, including all work on Mastering Chemistry and any assignments posted in Canvas. Late work will not receive credit. Incompletes will only be assigned in extremely unusual circumstances. Quizzes and exams will not have make-up opportunities without my prior approval (see “Exams” under “Grading and Assessment” for more details).

PLNU Attendance and participation policy: Regular and punctual attendance at all class sessions is considered essential to optimum academic achievement. If the student is absent for more than 10 percent of class sessions (i.e., 5 or more absences), the faculty member will issue a written warning of de-enrollment. If the absences exceed 20 percent (i.e., 9 or more absences) by the last day to drop (March 24), the student may be de-enrolled without notice. If a student has a third absence **after** that deadline, they may receive a W or WF, depending on their work and participation up to that point. **There are no allowed or excused absences except** as approved in writing by the Provost for specific students participating in certain university-sanctioned activities (e.g., a student athlete who cannot attend due to a scheduled game). These are the **only** absences that do not count towards the 20 percent absence threshold.

PLNU academic honesty policy: Students should demonstrate academic honesty by doing original work and by giving appropriate credit to the ideas of others. Academic dishonesty is the act of presenting information, ideas, and/or concepts as one's own when in reality they are the results of another person's creativity and effort. A faculty member who believes a situation involving academic dishonesty has been detected may assign a failing grade for that assignment or examination, or, depending on the seriousness of the offense, for the course. Faculty should follow and students may appeal using the procedure in the university Catalog. See [Academic Policies](#) for definitions of kinds of academic dishonesty and for further policy information.



(Ironically, it took me a long time to find a copy of this comic that hadn't had the author's name deleted.)

PLNU copyright policy: Point Loma Nazarene University, as a non-profit educational institution, is entitled by law to use materials protected by the US Copyright Act for classroom education. Any use of those materials outside the class may violate the law.

Spiritual care: PLNU strives to be a place where students grow as whole persons. To this end, we provide resources for our students to encounter God and grow in their Christian faith.

If you have questions, a desire to meet with the chaplain, or if you have prayer requests, you can contact the [Office of Student Life and Formation](#).

State authorization: State authorization is a formal determination by a state that Point Loma Nazarene University is approved to conduct activities regulated by that state. In certain states outside California, Point Loma Nazarene University is not authorized to enroll online (distance education) students. If a student moves to another state after admission to the program and/or enrollment in an online course, continuation within the program and/or course will depend on whether Point Loma Nazarene University is authorized to offer distance education courses in that state. It is the student's responsibility to notify the institution of any change in his or her physical location. Refer to the map on [State Authorization](#) to view which states allow online (distance education) outside of California.

Sexual misconduct and discrimination: Point Loma Nazarene University faculty are committed to helping create a safe learning environment for all students. If you (or someone you know) have experienced any form of sexual discrimination or misconduct, including sexual assault, dating or domestic violence, or stalking, know that help and support are available through the Title IX Office at pointloma.edu/Title-IX. Please be aware that under Title IX of the Education Amendments of 1972, it is required to disclose information about such misconduct to the Title IX Office. If you wish to speak to a confidential employee who does not have this reporting responsibility, you can contact Counseling Services at counselingservices@pointloma.edu or find a list of campus pastors at pointloma.edu/title-ix

PLNU academic accommodations policy

PLNU is committed to providing equal opportunity for participation in all its programs, services, and activities. Students with disabilities may request course-related accommodations by contacting the Educational Access Center (EAC), located in the Bond Academic Center (EAC@pointloma.edu or 619-849-2486). Once a student's eligibility for an accommodation has been determined, the EAC will issue an academic accommodation plan ("AP") to all faculty who teach courses in which the student is enrolled each semester.

PLNU highly recommends that students speak with their professors during the first two weeks of each semester/term about the implementation of their AP in that particular course and/or if they do not wish to utilize some or all of the elements of their AP in that course. Students who need accommodations for a disability should contact the EAC as early as possible (i.e., ideally before the beginning of the semester) to assure appropriate accommodations can be provided. It is the student's responsibility to make the first contact with the EAC.

CHE 3025: Physical Chemistry I: Tentative schedule

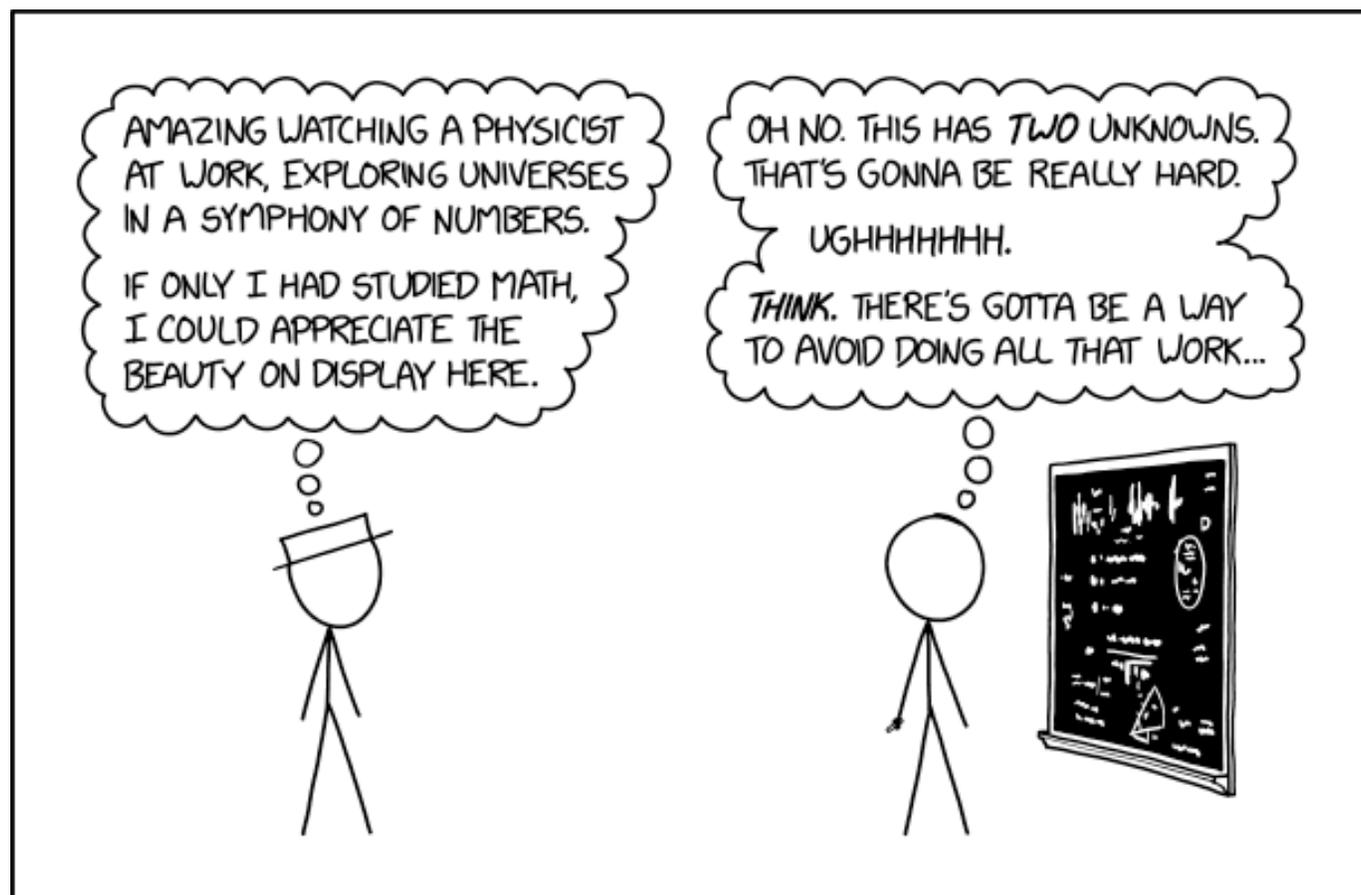
The schedule may change during the semester. Watch Canvas for updates.

Almost all class days have prelecture assignments due 8am and homework assignments that are due 11:59pm.

(*) indicates quiz days

Day	Topics	Pre-Read	Lab
T Jan 10	Thermodynamics Concepts	ME1, 1.1-1.5	No lab
W Jan 11	First Law, Heat, Work, Reversibility	ME2, 2.1-2.4	
F Jan 13	Work	ME3, 2.5-2.7	
M Jan 16	<i>No class due to Martin Luther King, Jr Day</i>		0: Math: Shepherd M1
W Jan 18*	State and Path Functions, Heat Capacity	2.8-2.11	
F Jan 20	Enthalpy, Adiabatic Expansion/Compression (last day to add)	2.12-2.14	
M Jan 23	Internal Energy with V and T	3.1-3.3	1: Joule-Thompson coeff.
W Jan 25*	Heat Capacity and Enthalpy	3.4-3.6	
F Jan 27	Joule-Thompson	3.7-3.8	
M Jan 30	Enthalpy of Reaction	4.1-4.3	1: Joule-Thompson coeff.
W Feb 1*	Temperature and Calorimetry	4.4-4.5	
F Feb 3	Entropy, Second Law, Clausius Inequality	5.1-5.5	
M Feb 6	Entropy of Surroundings, Third Law	5.6-5.7	2: Bomb Calorimetry
W Feb 8*	Entropy of Reaction, Heat Engines	5.8-5.10	
F Feb 10	Entropy with V, T, and P, Applications	5.11-5.13	
M Feb 13	EXAM 1: Ch. 1-5		2: Bomb Calorimetry
W Feb 15	Gibbs Energy	6.1-6.3	
F Feb 17	Gibbs of Reaction	6.4-6.6	
M Feb 20	Chemical Equilibria	6.7-6.10	3: Gas-phase rxn
W Feb 22*	Applications	6.11-6.14	
F Feb 24	Real Gases	7.1-7.5	
M Feb 27	Phase Diagrams	8.1-8.4	3: Gas-phase rxn
W Mar 1*	Calculations, Applications	8.5-8.10	
F Mar 3	Ideal Solutions	9.1-9.5	
Mar 6-10: No class due to Spring Break		-	
M Mar 13	Colligative Properties, Real Solutions	9.6-9.10	4: VdW isotherms, comp
W Mar 15*	Solution Equilibria	9.11-9.15	
F Mar 17	Electrolyte Solutions, Electrochemistry	10.1-11.3	
M Mar 20	Electrochemical Cells, Applications	11.4-11.13	4: VdW isotherms, comp
W Mar 22	EXAM 2: Ch. 6-11		
F Mar 24	Probability, The Boltzmann Distribution (last day to drop)	12.1-13.5	
M Mar 27	Ensembles and Partition Functions	14.1-14.4	5: Speed of sound
W Mar 29	Molecular Partition Functions	14.5-14.10	
F Mar 31	Statistical Thermodynamics	15.1-15.7	
M Apr 3	Kinetic Theory of Gases	16.1-16.7	5: Speed of sound
W Apr 5*	Transport Phenomena (time permitting)	17.1-17.9	
F Apr 7	Apr 6-10: No class due to Easter Recess		

Day	Topics	Pre-Read	Lab
M Apr 10	<i>Apr 6-10: No class due to Easter Recess</i>	–	
W Apr 12	Reaction Rates	18.1-18.3	6: Kinetics
F Apr 14	Integrated Rate Laws	18.4-18.6	
M Apr 17	Reaction Mechanisms	18.7-18.10	
W Apr 19*	Potential Energy Surfaces	18.13-18.15	6: Kinetics
F Apr 21	Preequilibrium, Lindemann Mechanism	19.1-19.3	
M Apr 24	Catalysis, Radical Reactions, Explosions	19.4-19.7	
W Apr 26	Photochemistry, Electron Transfer	19.8-19.10	No lab: Due dates
F Apr 28	EXAM 3: Ch. 12-19	–	
M May 1	COMPREHENSIVE ACS FINAL EXAM Monday 7:30 – 10:00 am (See Final Exam Schedule)	Ch. 1-19	No Lab



xkcd.com/2207